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The Soviet Fertilizer Industry: Development in the 1970s and Outlook for the 1980s

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An Intelligence Assessment

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An Intelligence Assessment

This paper was prepared by Office of Soviet Analysis.

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Key Judgments

Information available as of 30 April 1983 was used in this report.

Aided by large imports of Western equipment and technology, the Soviet Union has become the world's leading fertilizer producer. Output of fertilizer nutrients grew by a total of 90 percent during the 1970s. Nearly 70 percent of this growth occurred before 1975, however.

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The main causes of the growth slowdown during the 10th Five-Year Plan (1976-80) were (a) lags in expanding capacity for supplying the raw materials and intermediates used in the production of fertilizer and (b) the underutilization of existing capacities at all stages of the production process. Because these problems are continuing into the 1980s, the goal to produce 36 million tons of nutrients in 1985 appears to be out of reach. We estimate that the Soviets will produce approximately 30 million tons of fertilizer nutrients in 1985, an increase of more than 20 percent over 1980. One-half of the planned increase is to come from greater utilization of old and new capacity.

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This shortfall will put a sizable roadblock in front of the Soviet Union's Food Program. Moscow has placed a high priority on increased use of fertilizer to boost farm output. Applications on crops grew by two-thirds in 1971-75, exceeding the plan. But the marked shortfall in fertilizer production in 1976-80 limited shipments to farms to less than 19 million tons in 1980—a 9-percent increase over 1975 and 30 percent less than plan. We judge that farm use in 1985 again will fall short of plan and probably will be in the range of 23-24 million tons of nutrients. Such a shortfall would require the Soviets to import 13-16 million tons of grain worth about $1.5-2 billion at 1982 prices.

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Despite the marked shortfall in domestic availability, fertilizer exports have grown rapidly. Exports in 1980 totaled nearly 4 million tons of nutrients, more than twice the level in 1970. Hard currency sales of nearly $200 million accounted for one-fourth of the value with most of the rest exported to CEMA countries.

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We estimate that the USSR will remain a net importer of grain and a net exporter of fertilizer. Even though the relationship between world fertilizer and grain prices argues for using fertilizer domestically, the Soviets have chosen to continue to export. A variety of reasons may influence export policy in the face of these relative prices and the dire need to expand farm output, including commitments to CEMA client states and Western countries, continued lack of supporting infrastructure for distributing and storing

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fertilizers and a shortage of application equipment, the lack of sufficient phosphate fertilizer to provide an appropriate balance with the available nitrogen and potassium fertilizer, and the need for hard currency earnings.

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Exports of nitrogen and potash fertilizer nutrients in 1985 could amount to 5-5.5 million tons, with sales for hard currency earnings of perhaps $200-400 million in 1982 prices. The USSR is also the world's largest exporter of ammonia—a key intermediate product. Shipments in 1980 amounted to about 2.2 million tons—one-third of the world trade in this product. Most of the ammonia exported is associated with buy-back deals for Western equipment or with a fertilizer exchange agreement with a US firm. The Soviets are already committed to export about 3.2 million tons of ammonia in 1985 worth about $450 million in 1982 prices.

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Shortages of high-quality phosphorus fertilizers will continue to be especially troublesome for Soviet planners. Over 55 percent of the arable land in the USSR is seriously deficient in phosphorous, which is particularly important for hastening the maturing of grain in areas that have short growing seasons. Although the Soviets have large reserves of phosphate raw materials, a shortage of high-quality reserves means that domestic supplies probably will have to be supplemented by purchases on world markets.

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To support its massive fertilizer program, the USSR purchased $360 million worth of equipment from the West in the 1960s. Orders soared to about $3 billion in 1971-80, one-third of the value of all chemical equipment and technology ordered from the West. Despite the critical role Western equipment and technology played in obtaining the large gains in fertilizer output since 1960, Moscow has been disappointed by the returns on the heavy hard currency outlays. The difficulties encountered in assimilating these imports probably is one of the major arguments of those within the Soviet Union who oppose increased reliance on Western technology in the 1980s.

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The Soviet Fertilizer Industry: Development in the 1970s and Outlook for the 1980s

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Introduction

The Soviet Union is the world's largest producer of chemical fertilizers, accounting for more than one-fifth of global output.[1] Fertilizer is the single most important factor in raising Soviet crop yields. The Soviets claim that more than one-third of the country's gross agricultural product in 1976-80 was obtained with the use of chemical fertilizers.

Determined to maintain the momentum in expanding farm output achieved in the previous two decades, the Soviets adopted plans for a continued rapid expansion of fertilizer output in the 1970s and sought Western help to carry out the program. This report reviews the development of the Soviet fertilizer industry during the 1970s, the causes for the marked slowdown of growth since the mid-1970s, and the outlook for fertilizer production, supplies, and exports in the 1980s. The contribution of Western equipment and technology is also examined.

Background

Increased crop yields in the Soviet Union since 1960 have resulted mostly from increased use of fertilizers. Prices for fertilizer and crops have been structured to encourage fertilizer use in part by setting the state-controlled prices charged farms for fertilizer below production costs. A Western study indicates that in the late 1970s roughly 37 percent of the cost of fertilizers delivered to farms was covered by state subsidies. Grain and other crop prices are set sufficiently high that, on average, fertilizer use has been extremely profitable.[2] Planned allocation of fertilizers has been designed to provide farms with the amount they need to meet targets for crop yields. In practice, however, production and delivery bottlenecks have meant that actual allocations rarely have been sufficient to meet the plan for grain, even if precipitation is adequate. Farm applications also have been limited by serious losses in transport and storage and inadequate supplies of application equipment (see inset and table 1).

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We have no information on the productivity of capital and labor inputs to the Soviet fertilizer industry; however, the Soviets do publish data on the chemical industry as a whole (see table 2). After rising during the first half of the 1970s, total factor productivity fell in the last half of the decade and continued to fall more steeply in the 1980s.

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Analysis described in the remainder of this paper will show that the situation in the fertilizer industry was even worse. In particular, because the fertilizer industry had more underutilized capacity on average than the chemical industry as a whole, trends in capital and labor productivity probably were more unfavorable.

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Investment and Western Technology

Rising Investment Costs

Development of the fertilizer industry has received high priority since the mid-1960s. The share of total chemical investments being channeled into fertilizer plant and equipment increased from roughly 30 percent in 1966-70 to nearly three-fifths by 1980.[3] The

[1] In this report, "fertilizer" is defined as chemical fertilizer and excludes organic fertilizer.

[2] The financial incentive to fertilize wheat crops is relatively greater in the USSR than in the United States. For example, the ratio of wheat prices to fertilizer prices in recent years was 0.68 for the USSR and 0.42 for the United States. Soviet experts estimated that using mineral fertilizer during 1971-75 resulted in a return in additional production worth more than double the outlay

[3] The Soviet Union publishes statistics annually on its expenditures for gross new fixed capital investment. The data are expressed in 1973 prices and include expenditures on imported machinery and equipment. We are uncertain, however, how the Soviets convert the cost of their machinery imports into the 1973 ruble price base used to construct the published investment statistics. Western analysis suggests that imported machinery is valued in domestic prices by means of conversion coefficients. During 1972-78 these conversion coefficients were approximately one; that is, "external rubles" were simply translated into "domestic rubles" without adjustments. We do not know whether the data are then converted to a 1973 price base using a price deflator.

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Soviet Chemical Fertilizers

Soviet chemical fertilizers are divided into three main groups: nitrogen, phosphate, and potassium (potash). Multinutrient or complex fertilizers contain two or three of these main elements and sometimes trace elements or microelements. Ammonia, more than 90 percent of which is obtained from natural gas, is the key intermediate in the production of nitrogen fertilizers. Ammonium nitrate (34 percent nitrogen) and urea (46 percent nitrogen) are the major types of nitrogen fertilizer produced in the USSR. Phosphate fertilizers such as single and triple superphosphate are produced by treating phosphate rock—apatite or phosphorite—with sulfuric and phosphoric acid. Phosphate rock also is applied directly in the form of ground phosphorite meal. Potash fertilizers are based mainly on the potassium salts, sylvinite and kainite. Most of the potash fertilizers produced in the USSR are in the form of potassium chloride.

[a] *Ammofos (monoammonium phosphate) is classified as a complex fertilizer in the USSR but not in the West.*

Complex fertilizers include: (1) compound fertilizers, which are produced as chemical compounds in a unified production process such as ammofos (monoammonium phosphate),[a] nitroammofoska, and nitroammofos, and (2) mixed fertilizers, which are physical mixtures of simple fertilizers.

Fertilizer output is expressed in (a) standard units (a Soviet statistical concept), (b) 100-percent nutrients (N, P_2O_5, K_2O), and (c) physical weight. Under the standard unit concept, nitrogen fertilizer contains 20.5-percent N; phosphate fertilizers, 18.7-percent P_2O_5; and potash fertilizers, 41.6-percent K_2O. Plant capacities are reported in metric tons of physical weight.

Data on fertilizer in this report are expressed in nutrients unless otherwise indicated.

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Table 1
Principal Inputs and Products of the Soviet Fertilizer Industry [a]

	Nitrogen	Phosphate	Potassium (Potash)
Raw material	Natural gas	Apatite	Sylvinite
		Phosphorites	Carnallite
		Pyrites	Kainite
		Sulfur	
Intermediate	Ammonia	Sulfuric acid	
	Nitric acid	Phosphoric acid	
		Yellow phosphorus	
End product	Ammonium nitrate	Single superphosphate	Potassium chloride
	Urea	Triple superphosphate	Potassium sulfate
	Ammonium sulfate		Mixed potassium salts
	Ammonia, aqua and anhydrous		

[a] Multinutrient or complex fertilizers are made from two or three basic elements. Principal types are ammonium phosphate (ammofos) and complex fertilizers, which contain nitrogen, phosphorus, and potassium.

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Table 2 *Percent*
USSR: Average Annual Rates of Growth of Productivity in the Chemical Industry

	1971-75	1976-80	1981-82
Total	**2.6**	**−1.1**	**1.6**
Labor	6.3	2.2	1.6
Capital	−1.8	−5.0	−5.5

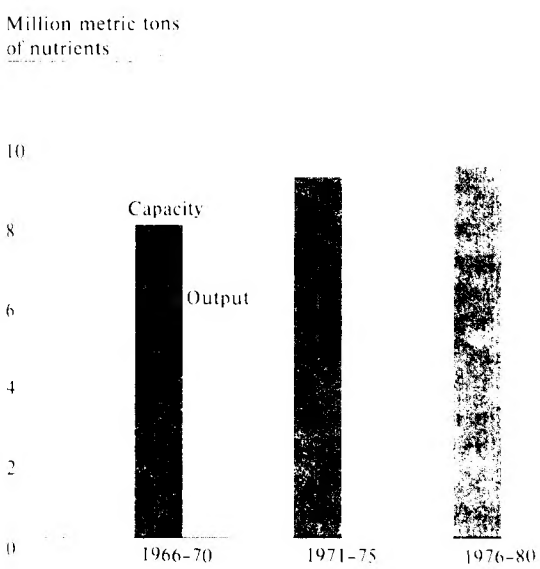
surge in investment has not been associated with a comparable rise in newly commissioned plant and equipment. Despite the quadrupling of investment, the increase in capacity during 1976-80 was only 20 percent above that achieved during 1966-70. Investment costs per unit of finished capacity amounted to 1,326 rubles per ton in 1976-80, a 77-percent increase over 1971-75 and more than three and a half times the 1966-70 level. The boost in cost reflects difficulties in the assimilation of new, highly sophisticated technology and the rising cost of imported equipment. At the same time, the increase in the output of fertilizer in 1976-80 fell sharply to only one-half that of 1966-70 and to less than one-third that of 1971-75 (see figure 1 and appendix A, table A-1). It is not likely that a surge of retirements offset these large commissionings. Therefore, the gap between the increments to production and capacity is probably real and has rapidly widened since the mid-1970s.

Role of Imported Equipment

Because of the failure to adequately expand capacity of the domestic chemical machine-building sector, the USSR has imported a large number of facilities for producing fertilizer and related raw materials. Fertilizer and fertilizer-related equipment accounted for more than one-third of the $9 billion of Western chemical equipment and technology ordered by the USSR during 1971-80.[4] Orders peaked in 1976, reaching more than $900 million (see appendix B).

[4] Values of chemical equipment orders are in current prices. Appendix B provides a list of individual contracts for purchases of fertilizer equipment and technology from non-Communist countries during 1971-81

Figure 1
USSR: Increase in Fertilizer Production Capacity and Output



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Since 1969 the Soviets have made 13 purchase agreements with Western firms involving 45 ammonia plants.[5] In roughly the same period, they ordered seven urea plants, 15 multinutrient fertilizer plants, and eight phosphoric acid plants from Western companies. An additional six urea plants, incorporating Western technology, were imported from Czechoslovakia. Many of the fertilizer plants purchased from the West in recent years have been associated with product buy-back or "compensation" deals under which Western firms agree to long-term purchases of Soviet ammonia, urea, and potash.

As a result, Western equipment and technology have contributed heavily to production of ammonia, nitrogen, and complex fertilizers, although inefficiency in

[5] Five of these plants were built in the 1970s under an earlier agreement and incorporate French technology and Soviet and Czechoslovak equipment.

construction and operation of these plants has denied the USSR the full benefits.[6] With Western assistance, Soviet output of ammonia and nitrogen fertilizers doubled in the 1970s. Large ammonia plants based at least in part on Western technology provided more than 90 percent of capacity introduced during this period. If operated properly, the large-scale Western-origin plants currently used in producing over half of total ammonia output can lower the cost of production by 40 percent, require half the number of personnel, reduce unit energy expenditures by 20 to 25 percent, and use substantially less steel. Four of seven urea plants ordered from the West in 1974-76 plus five purchased in the early 1960s contributed about 40 percent of 1980 urea output.[7]

A 2,450-kilometer ammonia pipeline ordered from France and the United States in 1975 was completed in 1981 (see figure 2). The pipeline, which has an annual capacity of 2.5 million tons, runs from Tol'yatti to the port of Yuzhnyy, near Odessa, with a spur to Gorlovka. Most of the ammonia carried by it will be exported, but the line eventually will also deliver 250,000 tons of liquid ammonia per year to farms in the RSFSR and the Ukraine. In connection with the Soviet Union's fertilizer exchange agreement with Occidental Petroleum Corporation (see page 15), two chemical export terminals were constructed with Western aid at Yuzhnyy on the Black Sea and at Ventspils on the Baltic.

The USSR also obtains some equipment for fertilizer-related plants from other East European countries. The Soviets have ordered about 45 large-scale sulfuric acid plants from Poland, more than one-half of them since 1975. In addition to the urea plants, Czechoslovakia has supplied 22 steam reforming units for ammonia plants and is scheduled to supply an additional 15.[8]

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The Fertilizer Industry in the 1970s

Production

The Soviet Union is richly endowed with most of the necessary raw materials for a fertilizer industry—particularly natural gas and potash. By 1974 it was already the world's largest producer of fertilizer. End products are produced in about 85 main plants; most are located in the European part of the USSR (see figure 3). The two main sources of phosphate rock are the Kola apatite mines in the far north of the European USSR, which currently supply over three-fourths of domestic output, and the Karatau phosphorite mines in southern Kazakhstan, which supply most of the rest as well as an important quantity for transformation into elemental phosphorus. The USSR does not possess phosphate reserves at a location where large-scale *in situ* manufacture of fertilizers is economically favorable. The deposits are remotely sited both in relation to the market and to any sulfur supply source; consequently, the phosphate fertilizer industry has been built up at fertilizer-consuming locations and sulfur-producing metal smelters. The USSR has two major centers of potash production in the Western Urals and in Belorussia and a smaller one in the Western Ukraine. (See appendix C for details concerning availability of raw materials.)

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In the first half of the 1970s the Soviets met goals for both production of fertilizer and deliveries to agriculture. Production in 1975 reached 22 million tons of nutrients, a nearly 70-percent increase over 1970 (see figure 4 and appendix A, table A-2). Nitrogen fertilizer output increased by 57 percent; phosphate fertilizer, by 54 percent; and potassium fertilizer, by 94 percent (see appendix A, table A-3). Shipments to farms in the same period also increased by 70 percent to 17.3 million tons of nutrients.

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[6] Three-fourths of all complex fertilizer output in 1973 came from imported plants. In 1980, only about one-fourth of complex fertilizer production in the USSR was from imported plants. Western technology provided a smaller share of the output because several Soviet-designed plants were commissioned during 1973-80 and because the US embargo on deliveries of superphosphoric acid feedstock in 1980 delayed operation of seven liquid complex fertilizer plants. During 1976-77 the Soviets purchased from the West eight installations for the production of dry complex fertilizers having a capacity of 2.8 million tons of nutrients. Western equipment for seven liquid complex fertilizer plants ordered in 1976 provided capacities for an additional 1.6 million tons, which will account for most of Soviet liquid complex fertilizer based on polyphosphoric acid. Hence, the share of output from foreign plants probably will rise in the future.

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[7] The real impact of Western urea technology will be felt in 1981-85 when five urea plants that began operation in 1979-81 reach full capacity and five of 12 plants ordered from Czechoslovakia that use Western technology are scheduled for commissioning.

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[8] These units decompose natural gas to produce hydrogen, one of the synthesis gases used in ammonia production.

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Figure 2
USSR: Tol'yatti-Yuzhnyy Ammonia Pipeline

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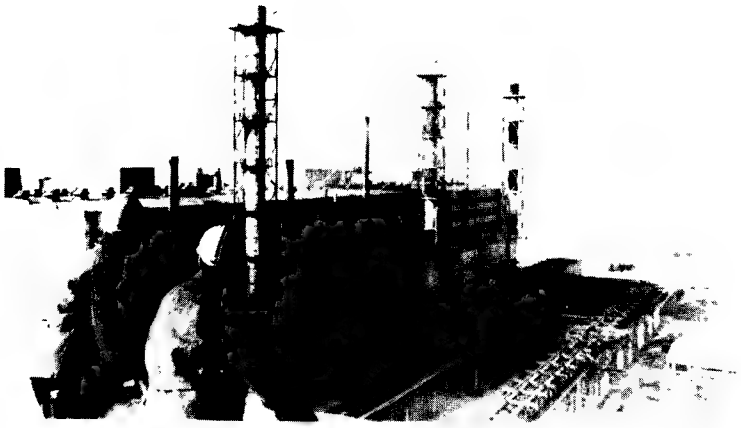

Phosphates plant at Chimkent

Mining potassium in the Verkhne-Kamsk deposits in the Urals Sovfoto ©

Anticipating continuing rapid growth in production, the 1976-80 Plan called for a nearly 60-percent rise in output. But production of fertilizer nutrients in 1980 was only 24.8 million tons, less than 13 percent above the 1975 level.

Sulfuric acid, a key intermediate in the production of phosphate fertilizer, increased by 55 percent in 1971-75. In 1976-80, however, output rose by only 23 percent, a one-fourth shortfall from plan.

Quality and Assortment

The production mix has been a major problem of the fertilizer industry. The USSR has been unable to raise its output of phosphate fertilizer relative to nitrogen and potash. As a result, according to Soviet scientists, the application ratio of $N:P_2O_5:K_2O$ remains far below the optimum (see table 3). Over 55 percent of the available land in the USSR is seriously deficient in phosphorous, which is particularly important for hastening the maturing of grain in areas that have short growing seasons. Shortages of phosphate fertilizer in many regions have limited yields and reduced the quality of crops and the effectiveness of nitrogen fertilizers.

The assortment of various mixes of fertilizers also remains inadequate. Soviet scientists claim that it is necessary to double the variety of fertilizers to satisfy the needs of agriculture. Output of high-quality chlorine-free potassium fertilizers—necessary for use on buckwheat, grapes, citrus fruits, and beans—is low. Also, larger quantities of highly concentrated feed phosphates are needed.

On the other hand, the Soviets have been more successful in fulfilling the targets for raising the share of high-nutrient and complex fertilizers (see table 4). According to a Soviet study, the use of concentrated and complex fertilizer with a high nutrient content requires up to 30 to 40 percent less expenditure for transport, storage, and application and increases the yield of crops by up to 10 percent compared with the same amount of nutrient contained in single-type fertilizers.

In 1970, 30 percent of the output of phosphate fertilizers consisted of ground phosphate rock—a material inferior to water-soluble types, such as superphosphate, which are more accessible to plants. This share fell to 20 percent in 1975 and to 13 percent in 1980, and the share of concentrated phosphate fertilizers increased. In the case of nitrogen fertilizers, the share of higher nutrient urea and complex fertilizers has increased while the share of the lower quality form, ammonium nitrate, has decreased.

Although the output of large-crystal and granulated fertilizer in 1980 was 30 percent higher than in 1975 and the share of the inferior powder form lower,

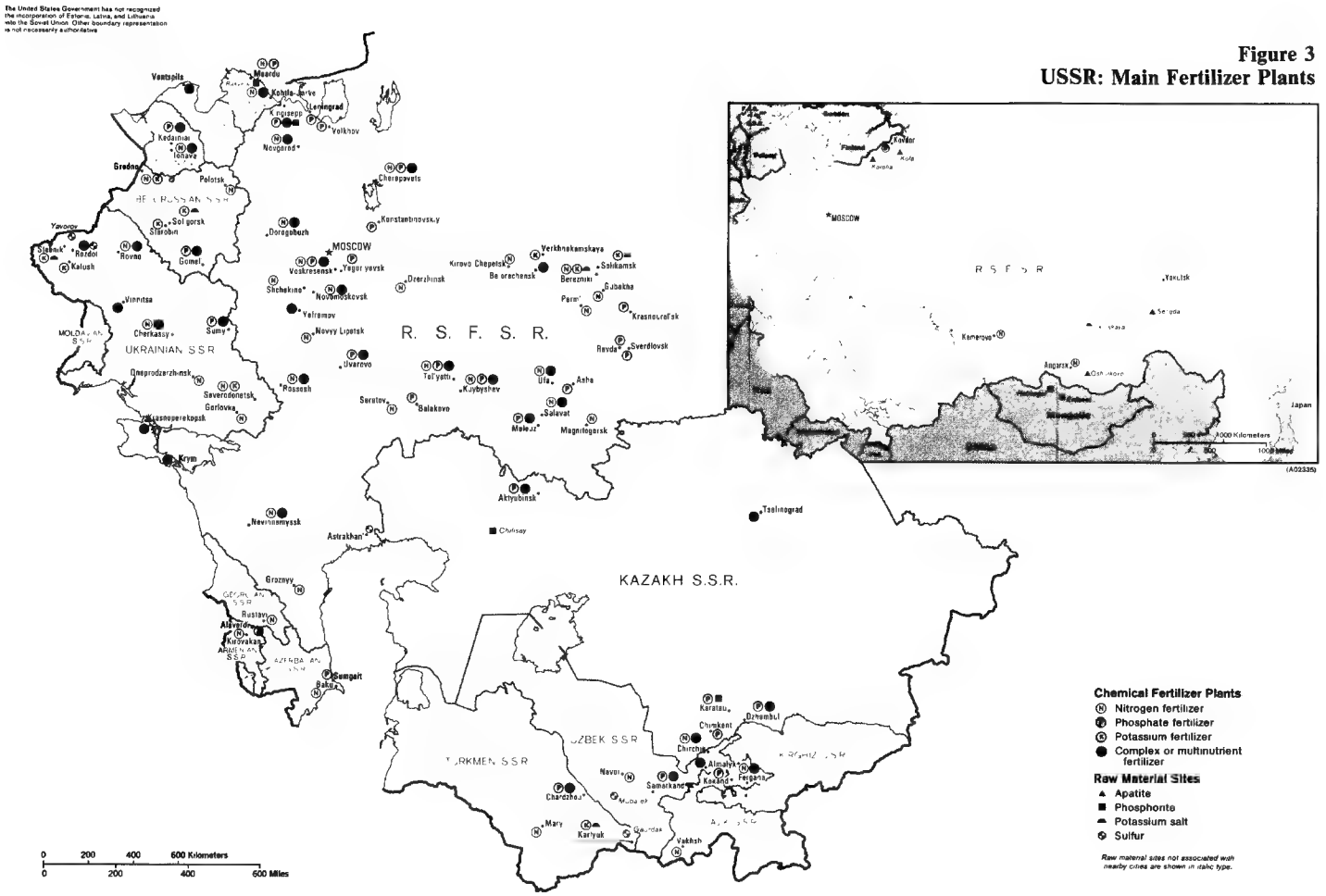

Figure 3
USSR: Main Fertilizer Plants

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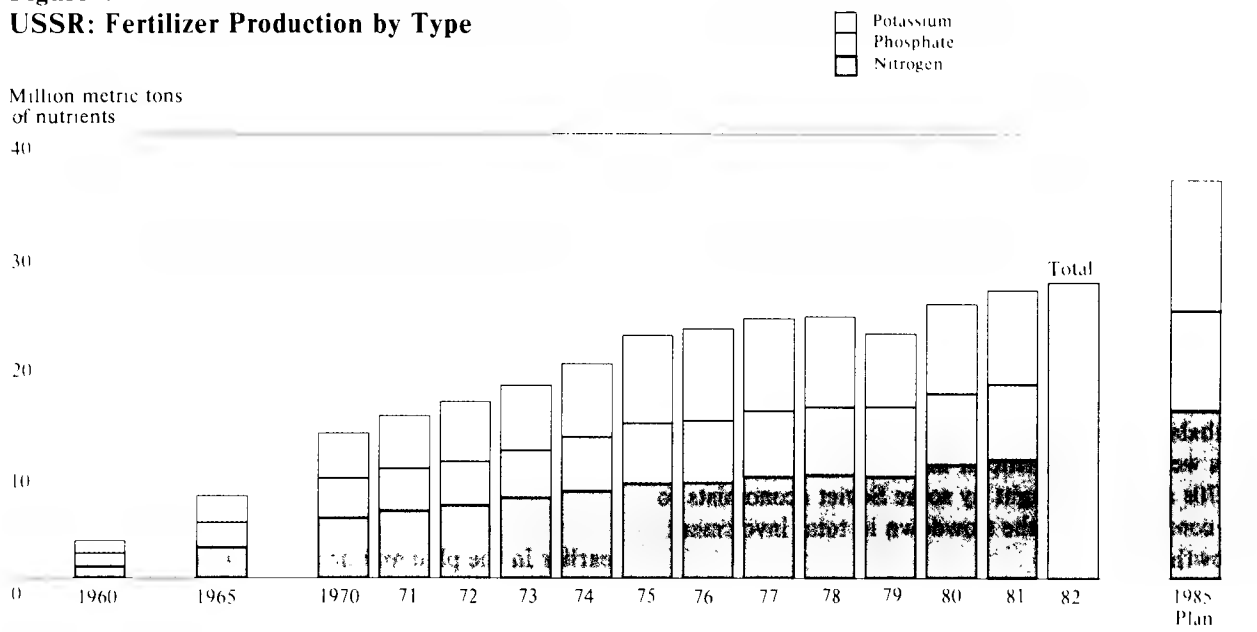
Figure 4
USSR: Fertilizer Production by Type



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caking is still a serious problem and results in large losses in transport, storage, and application. Excessive moisture and high acid content continue to lower the quality of some fertilizers. Quality control specialists at *Soyuzsel'khozkhimiya* (the association responsible for deliveries of chemicals to farms) believe that frequent violations in state quality standards may raise the acid content of the soil—already a problem in many areas.

Why the Production Shortfall?

The sharp slowdown in the growth of the fertilizer industry during the the last half of the 1970s had numerous causes. Some are longstanding but have become more serious in recent years.

The reasons for the slow growth of fertilizer output during 1976-80 can be put into two general categories: (a) lags in the commissioning of new capacities for the production of raw materials and intermediates used in the production of fertilizers and (b) the underutilization of existing capacities at all stages of the processes.

Deficiencies that contributed to construction delays and underutilization of completed capacities included shortages of skilled labor and feedstock, equipment failures, and transportation problems. Underlying these and other problems, according to a continuing drumbeat in the press, were poor management practices. The evidence suggests a worsening of these problems during the last half of the seventies—perhaps associated with the improper assimilation of a massive amount of foreign-origin plant and equipment for the fertilizer sector and for supporting industries.

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At a party plenum in 1979, Brezhnev criticized Leonid Kostandov, Minister of the Chemical Industry, for building plants that sat idle for lack of raw materials:

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> *It turns out that there are shortages of raw materials and gas. What were they thinking about earlier? Why did they allocate money for the construction of factories if they were not sure they would be able to operate? We are entitled to put these matters before Comrade Kostandov and the State Planning Committee.*

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Table 3
USSR: Fertilizer Application Ratios

	Optimal	Actual	
		1975	1980
Nitrogen (N)	1.0	1.0	1.0
Phosphate (P_2O_5)	1.1	0.59	0.62
Potassium (K_2O)	0.8	0.58	0.87

Table 4 *Percent*
USSR: Measures of Fertilizer Quality

	Actual				Plan	
	1965	1970	1975	1980	1980	1985
Average nutrient content	26	30	36	38	40	40-42
Share of high-nutrient and complex fertilizer	51	63	74	83	88	91

Sources: *Foreign Broadcast Information Service*, JPRS 78989, 16 September 1971; *Izvestiya*, 20 December 1981; *Planovoye khozyaystvo*, No. 7, July 1977; *Ekonomicheskaya gazeta*, No. 17, April 1982, pp. 1-2.

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Imbalances between input- and output-related capacities were characteristic of many industries in the late 1970s and are thought by some Soviet economists to be connected with the slowdown in total investment growth.

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Delays in achieving effective rates of operation often are related to a failure to bring interdependent units on stream at the same time. An ammonia plant might be completed a year or two before the associated urea plant, or a phosphoric acid plant might remain idle for a year until its sulfuric acid feedstock becomes available on site. For example, an ammonia plant at Rossosh (Voronezh Oblast, RSFSR) was completed almost two years after an associated ammonium nitrate plant. Failure to complete a long-delayed sulfuric acid plant at Yefremov (Tul'skaya Oblast, RSFSR) held up production of phosphate fertilizers.

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Project Completion

Poor planning and misallocation of investment resources within the chemical industry are two of the primary causes of construction problems. Also, construction resources often are dissipated by simultaneous construction of a large number of facilities. In 1975 Kostandov said that the fertilizer program for 1976-80 could be met if 10-12 million tons of capacity (standard units) were put into operation each year, but the Ministry of the Chemical Industry itself postponed 80 percent of the program for commissioning facilities until the second half of the five-year plan—causing many unfinished projects to be carried over into the 1981-85 Plan period. Perhaps the Soviets realized that it was impossible to meet these deadlines earlier in the plan and hoped to gather strength and shoot ahead. Things turned out differently, however, and less than half of the reduced 1976-78 assignment was fulfilled.

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The growth of uncompleted construction in the chemical sector has outstripped that in the rest of industry. According to Soviet statistics, the value of this construction reached 5 billion rubles by the end of 1975, an increase of 75 percent over 1970 compared with a 45-percent increase in other industrial sectors. It peaked in 1978 at more than 9 billion rubles, equivalent to two years' investment in the chemical sector. In an effort to expedite the completion of chemical projects, the number of new construction starts was reduced by more than two-fifths in 1979. As a result, the value of uncompleted capacity fell to 7.6 billion rubles by the end of 1980. The Soviets had even less success in the fertilizer sector of the chemical industry. The Soviet press reported that during the first three years of the 1976-80 Plan, unfinished construction increased by 50 percent, and uninstalled equipment valued at 1.6 billion rubles piled up.

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According to the Soviet press, output per employee is only about 50 percent of the norm on a whole series of fertilizer construction projects on which extensive resources have been concentrated. The reasons given

are poor preparation of construction sites and faulty procedures (inadequate and uneven supply of raw materials, poor scheduling, and shoddy workmanship) that require an unusual amount of followup time. As a result, thousands of tons of equipment, including imported machinery, sit unused at construction sites for years or sometimes are pilfered to finish other construction.

A Soviet journal reported that issuance of technical documentation for fertilizer projects is delayed by an average of two years, preventing timely arrangements for the manufacture of fabricated steel sections, precast concrete pipe, and other basic components. Flaws in documentation are common, necessitating changes that result in the overexpenditure of construction outlays. The machine-building plants frequently fail to deliver equipment on time, and, when it does arrive, it is often incomplete.

In the USSR the existing norm for putting a 400,000-ton-per-year ammonia plant on stream is six years—one and a half years for planning, three for construction, and one and a half for attaining full operation. In the industrial West it takes roughly two years to put a comparable plant on stream. In actual experience the Soviet norms usually are exceeded. Because equipment becomes obsolete in seven to eight years under today's conditions, the plant is often outdated when it begins operation.

Underutilized Capacity

The share of underutilized fertilizer capacity has grown substantially in recent years (see table 5) because of poor management, improper assimilation of foreign technology, poor design of Soviet equipment, labor and raw material shortages, and transportation delays.

According to the Soviet press, more than half of the fertilizer enterprises that have gone into operation in the past few years have failed to operate at capacity. In 1978 a survey of 21 fertilizer projects finished in 1971-75 revealed that they were operating at only 60 percent of capacity. Although ammonia production capacity expanded by 10 million tons during 1976-80, output increased by only 4.7 million tons. Similarly, capacities for 2.4 million tons of potassium fertilizer nutrients were commissioned during 1976-80, but output increased by only 120,000 tons. Calculations based on the total of new capacities added since 1961 suggest that overall capacity utilization ranged between two-thirds and three-fourths in 1979 (see figure 5 and appendix A, table A-4). The range in the estimate of the underutilization of capacity is determined by the assumption concerning the extent of retirement of capacity in place in 1961 (17 million tons of standard units).[9] We have no evidence that any of the production capacity installed after 1961 was retired during this period. A Soviet press report indicating a 76-percent capacity utilization rate in 1982 confirms these estimates.

The Karatau-Dzhambul phosphate fertilizer complex in Kazakhstan is one of the best examples of unused capacity. An article in the Soviet press claimed that, during 1976-80, production of fertilizer at this complex was only 45 percent of the planned level. A phosphate feed additive shop launched in 1980 was still idle in late 1981. In part this may have reflected

Table 5
Change in Underutilized Capacity Compared With 1975

Percentage points [a]

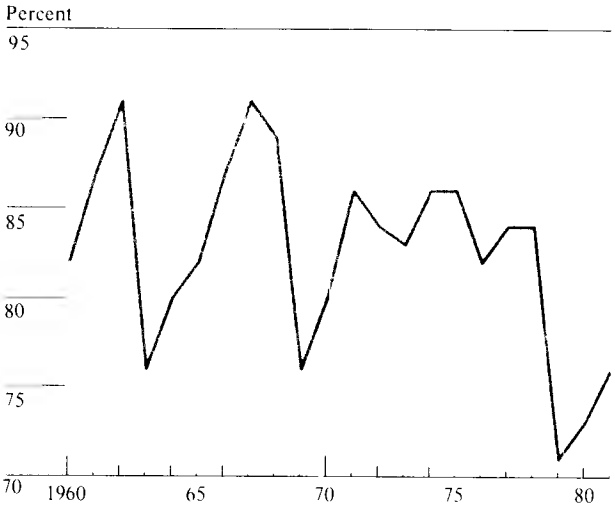
	1976	1977	1978	1979
Apatite concentrate	1.2	0.2	0	7.2
Synthetic ammonia	2.5	0.5	1.1	9.5
Sulfuric acid	2.0	2.9	1.7	7.2
Nitrogen fertilizer	5.3	4.7	4.1	10.5
Phosphate fertilizer	5.7	7.4	11.2	14.6
Potassium fertilizer	−1.4	−2.6	0.9	19.9

[a] A positive number indicates an increase in underutilized capacity.

Source: *Ekonomika i organizatsiya promyshlennogo proizvodstvo (EKO)*, No. 3, 1982, p. 46.

[9] The two-thirds figure assumes zero retirement; the three-fourths figure assumes the retirement by 1981 of all of the 17 million tons of capacity (all tons in this paper are metric). According to an article in the Soviet press, if the fertilizer industry had operated at full capacity in 1979, an additional 15 million tons of fertilizer (standard units) would have been produced, indicating that overall the industry operated at about 85 percent of capacity in that year.

Figure 5
USSR: Estimates of Fertilizer Plant Capacity Utilization



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the lack of adequate labor, at least of the appropriate mix of skills. The complex had only two-thirds of the planned labor force in 1981. Construction of housing and other supporting infrastructure for the labor force is lagging.

The Soviet press reported that disruptions in the operation of potassium and nitrogen fertilizer plants in the Berezniki (Perm' Oblast) area between 1976 and 1980 caused production shortfalls of 4.5 million tons of potassium fertilizer and 1.9 million tons of nitrogen fertilizer (probably standard units). Shutdowns were caused by shortages of railroad cars, outmoded and defective equipment, delays in deliveries of replacement equipment, and labor shortages. Labor productivity at the Uralkaliy potash plant in 1980 was lower than in 1975, and "violations of labor discipline" reportedly occurred 50 percent more frequently.

Equipment Problems. With the current emphasis on the economies of scale of large-unit plants, the technological and equipment problems that now idle capacity cause much larger shortfalls than in the past. Assimilation of advanced fertilizer technology has been hampered by improper handling and installation of machinery, defective equipment, maintenance problems, and difficulties in mastering new techniques. The assimilation of new sophisticated ammonia plants has been a particular problem. These large-scale plants require a highly complex system of assembly involving tanks, tubes, compressors, and other equipment with narrow tolerances. The four ammonia plants at the Tol'yatti complex supplied by a US firm were commissioned in 1978-79 but have had continuous problems, resulting in operations well below capacity. For example, the main compressors were damaged because of faulty installation, and turbine bearings were ruined when local operators started them without any lubrication. 25X1

in mid-1981 three plants were operating at only 10 percent of capacity and one plant was not operating at all because it had been scavenged for spare parts. 25X1

The notable failure to introduce new technology in the production of domestic machinery and equipment stands in sharp contrast to the importation of massive amounts of highly complex "state-of-the-art" machinery and equipment. Investment in the chemical machine-building industry has lagged sharply behind investment in the chemical industry. As a result, the fertilizer industry lacks the right composition of machinery for such a complex industry. Equipment is outmoded and of poor quality, lacks corrosion resistance, and wears out prematurely. 25X1

Western equipment operated three times longer than Soviet and East European equipment. New facilities outfitted with domestic equipment at the Soligorsk potash mine did not operate at the start because the design of the equipment was obsolete and its output was so low that redesigning and rebuilding of new equipment was necessary. A Soviet newspaper reported that because 25X1

of continuing problems the facility was producing at only 36 percent of capacity in early 1980, one year after startup.

The same report stated that large facilities for the production of nitric acid and ammonium nitrate at several nitrogen fertilizer plants were idle because of the poor quality of the equipment, especially turbocompressors supplied by Khabarovsk's Energomash plant.

Labor Problems. Contributing to the underuse of capacity has been a dramatic failure to meet the demands for skilled labor generated by the shift to a higher level of technology. Indicative of the major technological transition throughout the chemical industry was the 125-percent total increase in the value of plant and equipment (constant prices) per worker in the 1970s in the chemical industry compared with the 95-percent increase for the balance of industry. During the same period the number of graduates in chemical technology from higher and specialized secondary schools fell 16 percent.

Fertilizer and related raw materials sectors were among the most seriously affected by the skilled labor shortage in the chemical industry in 1976-80. Workers are poorly trained, a situation worsened by weak engineering and technical guidance. Low output of many fertilizer plants is ascribed increasingly to the fact that workers' skill levels are below those required by the rising technical level of production. In large single-train ammonia plants, for example, operators need one and a half to two years of training, compared with three to four months in older plants. As in all of Soviet industry, an excessive number of personnel are engaged in relatively unskilled auxiliary work such as packaging, sorting, loading, unloading, and repair.

Unpleasant and sometimes hazardous working conditions and a lack of housing and social amenities discourage employment in the fertilizer industry and result in a high labor turnover. It is especially difficult to attract skilled workers to plants located in rural regions of the Central Asian republics of the USSR. Consequently, fertilizer plants use a large number of labor camp prisoners who lack the necesssary skills, incentive, and discipline. at the Karatau-Dzhambul phosphate complex in Kazakhstan paroled prisoners comprised 90 percent of the work force in 1976 25X1 25X1

Feedstocks

Shortages of raw and intermediate materials also contributed to the poor use of production capacity during 1976-80.

Sulfuric Acid and Phosphate Raw Materials. Demand for phosphate raw materials is growing rapidly because the planned product mix requires very large increases in multinutrient phosphate-containing fertilizers. Inadequate supplies of sulfuric acid and phosphate raw materials helped keep increases in phosphate fertilizer to less than one-fourth of that originally scheduled for 1976-80. These deficiencies reflected problems in developing phosphate deposits and shortages of sulfur for sulfuric acid. The US embargo of superphosphoric acid (SPA) contributed to the shortfall in phosphate fertilizer output in 1980. In the tight phosphate market of 1980, the Soviets were able to replace only about half of the P_2O_5 that they had expected to receive from the United States. The United States is the only large-volume supplier of SPA, and seven Soviet liquid complex fertilizer plants purchased from France are specifically designed to use SPA as feedstock for the production of a fertilizer with a P_2O_5 content of 34 percent. 25X1 25X1

Natural Gas. Interruptions in supplies of Soviet natural gas, especially during the unusually severe winter of 1978-79, disrupted the production of ammonia. In addition, the supply of natural gas from Iran was interrupted in late 1978 and finally cut off in 1980, causing regional problems in ammonia production. 25X1

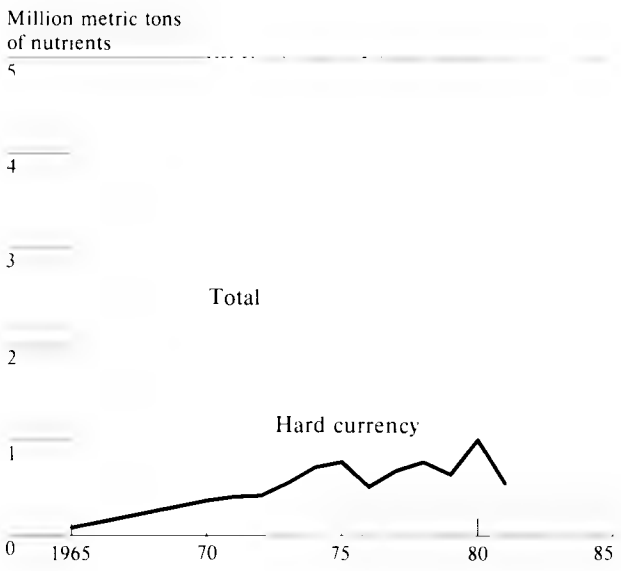
Nitric Acid. As indicated above, the Soviets have encountered serious technical problems with new domestically produced turbocompressors at several installations for nitric acid, an essential input for ammonium nitrate fertilizer. Large complexes for nitric acid and ammonium nitrate at Novgorod, Chirchik, Dorogobuzh, and Rossosh have frequently been idle because of poor-quality equipment. The resulting difficulties have delayed introduction and assimilation of new nitrogen fertilizer capacity. 25X1 25X1 25X1

Transportation

Finally, transportation problems have added to the stresses in the fertilizer industry. The growing production of fertilizers in the USSR is making delivery and storage an acute problem. Railroad cars are in short supply, many are damaged, loading operations are inefficient, and port facilities are inadequate. Furthermore, railroad personnel are little concerned with how much fertilizer is lost en route. The Soviets estimate that 10 to 15 percent of fertilizer is lost during transportation and storage, compared with about 5 percent in the United States. Over 90 percent of fertilizers are hauled by rail with an average haul of over 1,000 km. Extensive crosshauling burdens the lines unnecessarily. The turnaround time for railroad cars shipping fertilizers is 50 to 100 percent above the norm of six days. A shortage of packaging material and specialized cars compels the industry to ship 70 percent of all fertilizers in bulk in boxcars, and even in open gondola cars in violation of regulations. In addition, most railroad stations have no special unloading machinery or trackside roofed storage.

Transportation problems also complicate the supply of raw and intermediate materials. Phosphate and potash mines and beneficiation plants have been shut down periodically when storage facilities become saturated because of congested transport systems and railcar shortages. Shortages of railroad cars were a major factor contributing to the fall in potash output in 1979.

Figure 6
USSR: Fertilizer Exports



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Trade in Fertilizer and Feedstocks

Fertilizer

Although domestic use remains far below recommended and planned allocations, the share of fertilizer production going to exports has been rising. During 1976-80, fertilizer exports grew at an average annual rate of 5.4 percent, more than twice the growth rate in output. In 1980 Soviet exports of all fertilizers—nearly 4 million tons of nutrients—were more than twice the 1970 level (see figure 6 and appendix A, table A-4). Their 1980 value was equivalent to nearly $800 million, seven times that earned in 1970. Hard currency sales accounted for one-fourth of total exports and included some as compensation for purchase of Western production facilities. Nitrogen fertilizer sales tripled and potash sales doubled between 1970 and 1980. During the 1979/80 marketing year (July-June), the USSR accounted for about 15 percent and 8 percent, respectively, of world exports of potash and nitrogen fertilizers on a tonnage basis. The small quantities of phosphate fertilizers exported were at the 1970 level, reflecting priority domestic requirements. Small quantities of phosphate fertilizers also have been imported since 1971.

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Soviet exports of fertilizers go mainly to East European countries. In 1980, for example, 56 percent of total potash exports (nutrient basis) went to these countries. Major hard currency purchasers—Japan, Italy, and Belgium—accounted for 17 percent of total potash deliveries. Cuba, Czechoslovakia, Vietnam, and India were the principal customers for nitrogen fertilizers in 1980, accounting for nearly one-half of total nitrogen exports, while about one-fourth went to all East

Table 6
USSR: Ammonia Exports

Thousand tons of product

	1975	1976	1977	1978	1979	1980
Total	**88**	**163**	**203**	**718**	**1,680**	**2,200**
Of which:						
Western Europe	53	111	123	312	736	934
Eastern Europe	22	1	37	41	46	79
North America		8		342	855	1,000
Africa		8	15	11	31	55

Sources: *Vneshnyaya torgovlya*, 1975; *Fertilizer International*, No. 149, November 1981; United Nations trade data.

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European countries. In the same year more than one-fourth of Soviet urea shipments went to India, Cuba, and Pakistan.

Soviet policymakers probably entered into supply agreements during 1976-80 with bilateral trade partners, mainly East European countries, and with Western firms for product payback with the expectation that fertilizer production growth was going to be close to plan. With the marked shortfall in output during this period, deliveries to agriculture, rather than exports, suffered.

Exports of Fertilizer Feedstocks

The USSR is the world's leading exporter of ammonia, the key element in the production of nitrogen fertilizer. Soviet exports of ammonia jumped from 88,000 tons in 1975 to 2.2 million tons in 1980, accounting for about one-third of total world trade (see table 6). Agreements involving the purchase of 40 ammonia plants from the West require the foreign companies to buy back a percentage of the ammonia produced. About three-fourths of Soviet ammonia shipped in 1980 was associated with either a fertilizer agreement with Occidental Petroleum Corporation or compensation for Western equipment.

In the agreement between Moscow and the Occidental Petroleum Corporation concluded in 1973-74 and a number of subsequent contracts, trade was established in various fertilizer materials and services. The basic agreement is for a 20-year exchange of fertilizer materials, beginning in 1980. Occidental has agreed to sell 1 million tons of superphosphoric acid to the USSR each year and buy 1.5 million tons of ammonia and 1 million tons each of urea and potash. Smaller quantities of the same products were traded by the two parties in 1978 and 1979. Occidental is to buy an additional 600,000 tons of ammonia each year for 10 years starting in 1979. Soviet earnings from these sales are to provide funds to repay the US credits used to finance four ammonia plants purchased from another US firm and fertilizer handling and storage facilities provided by Occidental for two Soviet ports.

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Occidental agreed to purchase additional Soviet ammonia beginning in 1980 to compensate for the cost ($300 million) of equipment and services for the ammonia pipeline. Thus, planned annual purchases of ammonia by Occidental were to be substantially higher than in the original agreement. In January 1980, however, President Carter imposed a one-year quota on US imports of Soviet ammonia that limited shipments to about 1 million tons in 1980.[10] After the

[10] In October 1979 the International Trade Commission (ITC) ruled that ammonia imports were disrupting the US market and called on President Carter to impose quotas. In December 1979 President Carter rejected the recommendations of the ITC stating that import quotas would not be in the national interest. Under pressure from US ammonia producers who argued that low-priced ammonia imports were seriously damaging domestic production, Carter reversed his December decision and in January imposed a one-year quota on US imports of Soviet ammonia that limited shipments to 1 million short tons (about 900,000 metric tons).

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Soviet invasion of Afghanistan in late 1979, although the United States embargoed exports of all phosphate materials, including SPA, the Soviets continued to deliver ammonia to Occidental. US deliveries of SPA resumed in mid-1981.

The USSR also exports large quantities of phosphate rock in the form of apatite concentrate, about 80 percent of it to Eastern Europe. Soviet exports to Western Europe are currently less than 1 million tons, down from a peak of nearly 2.5 million tons in 1973. Despite domestic shortages, the Soviets were aggressively marketing high-quality apatite phosphate rock in Western Europe in early 1982 in an effort to prop up hard currency earnings. In addition to SPA from the United States, the Soviets also import small amounts of SPA and phosphate fertilizers from West European countries for hard currency.

In 1980 Japan and Italy probably received about 160,000 tons of urea as compensation for equipment.

As compensation for aid in the construction of the Kingisepp phosphorite complex, the Soviets agreed to ship monoammonium phosphate to several East European countries from 1976 to 1985. Bulgaria and Czechoslovakia receive about 85,000 tons (product weight) annually, and unspecified quantities go to East Germany and Hungary. Additionally, in payment for aid in developing the Soligorsk potash mine, the Soviets export 1 million tons of potash (K_2O) annually to Poland under an agreement ending in 1985.

Outlook for the 1980s

In an attempt to turn the fertilizer industry around, the Soviets established a separate Ministry for Fertilizer Production in November 1980. But many of the problems that plagued the industry during the 1970s are continuing to block achievement of the goals set for the 1980s.

Raw Materials

Raw materials used in the production of nitrogen and potassium fertilizers—natural gas and potash ores—are ample to support future production. Nonetheless, production costs are still increasing, and shortages of raw and intermediate materials for phosphate fertilizers persist. Domestic supplies of these materials probably will have to be supplemented by purchases on world markets. (A more detailed discussion of raw materials is presented in appendix C.)

Production Goals for 1985 [11]

In the 1981-85 period the USSR plans to increase fertilizer output by 45 percent, to 150.8 million tons of standard units (or about 36 million tons of nutrients), a large reduction from the preliminary goal of 170 million tons announced in 1978 (see table 7). The reduction undoubtedly was prompted by the huge shortfalls in fertilizer production in 1979-80 and perhaps in part by a realization that sufficient support facilities could not be provided to use effectively a larger volume of fertilizer in the 1981-85 period. To reach the current 1985 target, the increment in production would need to more than triple from its level in 1976-80, for an average annual rate of growth of 7.7 percent. Major increases would be needed in the output of two key intermediate inputs, ammonia and sulfuric acid.

Meanwhile, planned investment in the fertilizer industry in 1981-85 is 14 billion rubles, an increase of only 9 percent over the previous five-year period. The small boost in outlays for new plants and equipment, coupled with ambitious production targets, reflect an all-out effort to improve the utilization rates of plants already in operation. Minister of Fertilizer Production Petrishchev declared in a Soviet agricultural journal that over one-half of the increase in fertilizer production planned in the 11th Five-Year Plan will result from more intensive employment of old and new capacity. By the end of the period they expect to push

[11] The outlook for 1990 is discussed in appendix D.

Table 7
USSR: Fertilizer Production

Million tons

Type of Fertilizer	Actual 1980		Plan 1985		Percentage Increase 1981-85
	Standard Units	Nutrients	Standard Units	Nutrients	(Nutrients)
Total [a]	**103.9**	**24.8**	**150.8**	**36**	**45**
Nitrogen	49.9	10.2	74.2	15.2	49
Phosphate	30.1	5.6	44.5	8.3	48
Phosphorite meal	4.4	0.8	3.7	0.7	−13
Potash	19.4	8.1	28.1	11.7	44

[a] Includes small quantities of trace fertilizers and nitrogen and phosphate feeds.

Sources: *Narodnoye khozyaystvo SSSR v 1980 godu* and *Zhurnal vsesoyuznogo khimicheskogo obshchestva im. D. I. Mendeleyeva*, vol. XXVIII, No. 3, 1982, p. 11.

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capacity utilization up to the following levels: fertilizers, 95.2 percent; ammonia, 95.5 percent; and sulfuric acid, 93.2 percent.

If the utilization rate of fertilizer plants in 1980 ranged from 69 to 77 percent (see appendix A, table A-5) and the Soviets succeed in increasing the rate to 95.2 percent, they could produce an additional 5.8-9.4 million tons of nutrients just from plants operating in 1980 and over one-half of the increase in fertilizer production that is planned in this period would come from more intensive use of old capacity.

We estimate that the capacity utilization rate for ammonia averaged about 70 percent in 1980. If a 95.5-percent capacity utilization rate were achieved for ammonia plants in 1985, an additional 5 million tons of ammonia could be obtained annually from plants operating in 1980. These rates of utilization, however, are quite high, and unless the industry overcomes problems currently plaguing it, they will not be achieved.

Estimated Production in 1985

We estimate that total output of fertilizer in 1985 will amount to between 30 and 31 million tons of nutrients (instead of the planned 36 million tons), with the estimated composition of output shown in table 8. We believe a failure to produce and supply to agriculture planned amounts of fertilizer will be one of the reasons the Brezhnev Food Program will fall short of its goals.

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Nitrogen fertilizer output is difficult to project because of problems in estimating ammonia capacity in the 1980s. We lack information on Soviet-engineered plants and the retirement of smaller older plants. The Soviets probably will not succeed in their plans to build and put into operation 13 large-scale ammonia plants during 1981-85. Of the 13 plants, 10 were ordered from Japan in 1977. Construction of four of these apparently has not begun, and as a result, will be completed after 1985

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We estimate from information on plant construction that roughly 5 million tons of ammonia capacity will be added during 1981-85. With the additional contribution of plants that came on stream in 1979 and 1980 and some improvement in capacity utilization, we estimate the Soviets will produce roughly 23 million tons of ammonia in 1985. Of this, 3.2 million tons

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Table 8
USSR: Estimated Fertilizer Production, Supply to Agriculture, and Exports, 1985

Million tons of nutrients

	Production [a]	Supply to Agriculture [b]	Remainder	Exports [c]
Total	**29.8 to 30.6**	**23.2 to 23.9**	**6.6 to 6.7**	**5.2 to 5.5**
Nitrogen	13.0	10.0 to 10.3	3.0 to 2.7	2.6 to 2.4
Phosphate	8.0	7.0 to 7.2	1.0 to 0.8	0.1
Potash	8.8 to 9.6	6.2 to 6.4	2.6 to 3.2	2.5 to 3.0

[a] Including chemical feed additives.
[b] Excluding chemical feed additives.
[c] Relatively small quantities of nitrogen and potash balances will be used for nonfertilizer purposes. Most of the phosphate balance represents feed additives for animal husbandry.

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are earmarked for export in compensation and other agreements (see page 21). Of the remaining ammonia, about 16 million tons (equivalent to 13 million tons of nitrogen) probably will be used for fertilizer. Small quantities of ammonia are used for other industrial purposes.

Assuming the availability of Soviet phosphate raw materials and imports of about 1 million tons of P_2O_5 in the form of phosphoric acid, we estimate that Soviet phosphate fertilizer output will amount to nearly 8 million tons of nutrient in 1985. This increase will be primarily in the form of complex fertilizers. Much of the new capacity will depend on the Soviets' own design and construction capability, but several new complex fertilizer plants based on Western technology are expected to be commissioned during 1981-85.

Expansion of potash facilities should raise output to between 8.8-9.6 million tons of K_2O in 1985. The quality of the product will be improved through more widespread use of granulation facilities. At present only one-fourth of potash fertilizer is granulated.

Progress to Date

Fertilizer production in the 11th Five-Year Plan is off to a poor start. In 1981 output amounted to 26 million tons of nutrients, a 5-percent increase over 1980, but a 5-percent shortfall from plan. Fertilizer output fared worse in 1982, reaching 26.7 million tons of nutrients, less than 3 percent above 1981 production and a 7-percent shortfall from plan. Plans for 1983 call for a nearly 6-percent increase in fertilizer output.

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Bottlenecks in Other Sectors

The scheduled investment in the fertilizer industry and the plans for reducing losses will have to contend with the bottlenecks that have emerged in the provision of industrial supplies and transportation services. Shortages of steel, for example, are already curbing growth in machinery output. With a limited base for the production of machinery for the civilian sector, equipment for the oil and gas industry is likely to receive priority over the production of fertilizer equipment. Shortages of construction materials will persist. Cement production, which is very energy-intensive, is not expected to increase markedly.

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The outlook for transportation is not promising either. Production of rolling stock, which has decreased 3 percent annually since 1976, continues to decline. According to the Soviet press, in the first quarter of 1982, the Ministry of Railways supplied 14,000 fewer cars than targeted for agricultural chemicals, resulting in critical shortages of rolling stock at major

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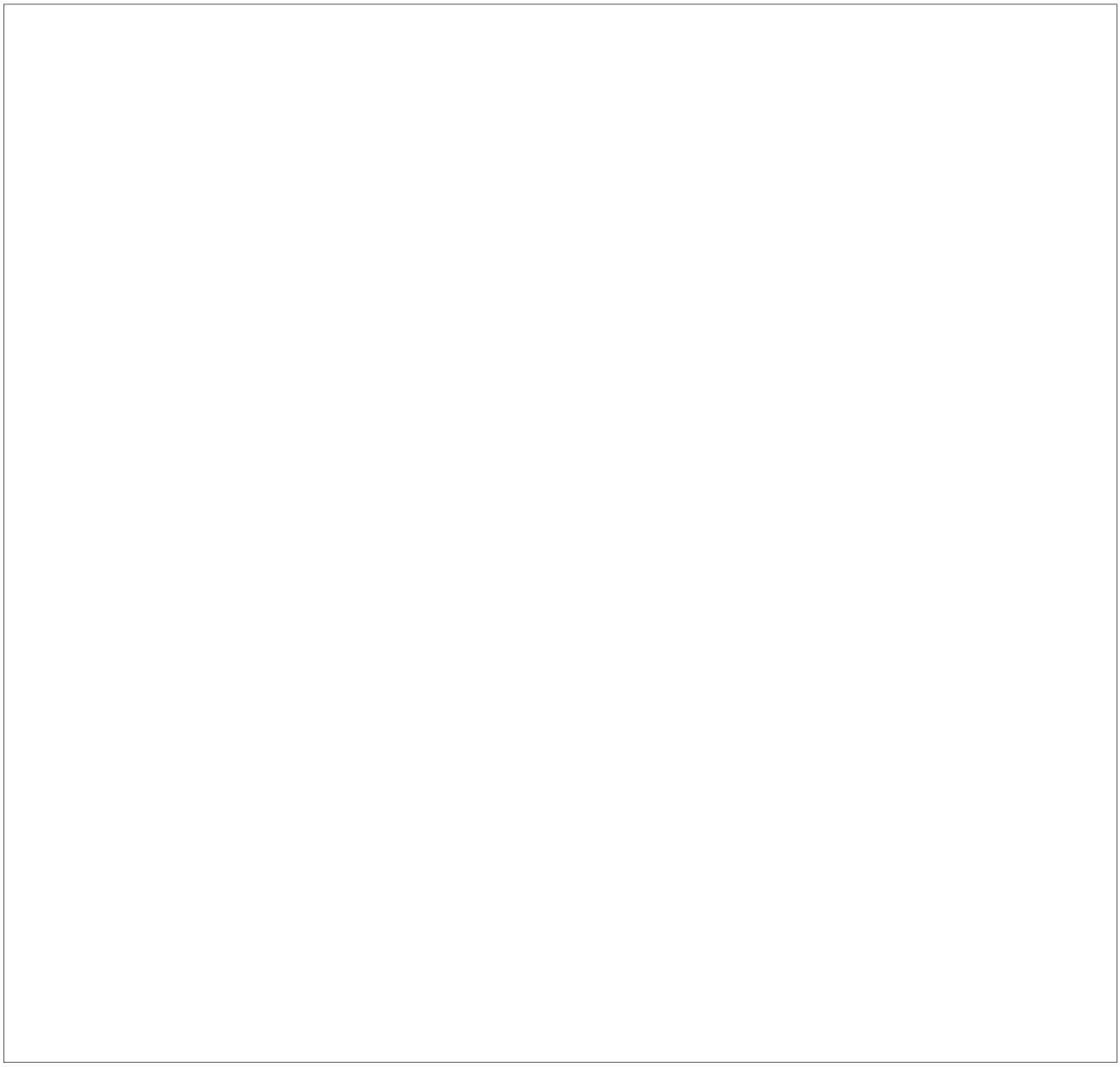

potash and phosphate raw material enterprises. Freight turnover for railroads in 1982 was 1 percent below the 1981 level. Additionally, roads in rural areas are in poor condition, hampering deliveries of fertilizers to farms.

Construction delays are continuing. In the current five-year plan about half of the new fertilizer production capacities—on the order of 5.2 million tons of nutrients—are scheduled for startup in 1983-84. In order to supply them, it was essential to complete raw material and intermediate projects scheduled for 1981-82. However, the Soviet press reported that of 20 fertilizer plants due for commissioning in the first 11 months of 1981, only two were successfully completed. The usual defects were blamed—sloppy work by Soviet contractors, delays in deliveries of building materials, and uncoordinated site work.

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- Failure to complete plants for sulfuric acid is holding up the development of phosphate fertilizer. Lack of housing at a sulfur mine in Yavorov prevented the startup of a completed plant in 1981.

- The Soviets have halted construction of an imported ammonia plant in Siberia and postponed the construction of another in Uzbek because of labor and construction material shortages.

- Plants continue to be underutilized. In October 1982 the Soviet press reported that production capacities were operating at only 76-percent capacity, with only 67-percent utilization at phosphate fertilizer enterprises where increased production is most urgent. In 1981, 25 of 30 fertilizer enterprises in the RSFSR were operating below capacity.

The fertilizer industry also will have to share in the general labor scarcity. A CIA study estimated that during the 1980s the working-age population will increase by only one-fourth as much as it did during the last half of the seventies. Also, because of this slowdown, the number of graduates in chemical technology from higher and specialized secondary schools probably will continue to fall.

Deliveries to Agriculture

Assuming the projected shortfall in production, we estimate that 23.2-23.9 million tons of nutrients will go to agriculture, with the composition by type as shown in table 8. According to Soviet scientists, agriculture needs 36.2-36.6 million tons of fertilizer nutrients, including 19.6 million tons for grain, to meet minimum norms.[12] Even if plans to deliver 26.5 million tons in 1985 are fulfilled, only three-fourths of these needs will be satisfied. If, as the Soviets claim, each ton of fertilizer nutrients produces an additional 5 tons of grain, the estimated shortfall in planned deliveries of fertilizer to agriculture in 1985 will cost 13-16 million tons of grain worth about $1.5-2 billion at 1982 prices.

[12] Excludes fertilizer for hay and pasturage. For each crop and climate zone of the country, Soviet scientists have established a range of optimal fertilizer applications. We used the lower end of the recommended range in making this estimate.

Trade Patterns

We estimate that the USSR will remain a net importer of grain and a net exporter of fertilizer. Even though the relationship between world fertilizer and grain prices argues for using fertilizer domestically, the Soviets have chosen to continue to export. A variety of reasons may influence export policy:

- Exports to Eastern Europe and selected Western trading partners are generally associated with bilateral trade agreements, reciprocal exchange agreements of chemicals and other products, and product buy-back for Western equipment. We expect the Soviets to honor these commitments.

- The Soviets may be physically unable to distribute, store, or apply larger amounts of fertilizer than we anticipate, because transport and storage facilities and application equipment will probably not be developed in consonance with the expansion of production.

- Application of additional nitrogen and potassium fertilizer with anticipated limited supply of phosphate fertilizer would further unbalance the fertilizer nutrient ratio, lowering overall fertilizer effectiveness.

In 1985 the Soviets could have an exportable "surplus" of about 2.5 million tons of nitrogen and 2.5-3.0 million tons of potash (K_2O). Allowing for shipments to Eastern Europe, payback on compensation deals, and exports to soft currency countries, fertilizer sales to hard currency customers in 1982 prices probably would be $200-400 million, with nitrogen fertilizer accounting for 60 to 75 percent of the value.[13]

The Soviets are committed to export in the mid-1980s large quantities of ammonia associated with compensation deals and other long-term contracts. The transactions listed in table 10 will commit for export annually at least 3.2 million tons of ammonia worth about $450 million in 1982 prices.

[13] Based on 1982 prices for urea and potash. Data exclude earnings from sales of ammonia.

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Table 10
USSR: Committed Ammonia Exports in Mid-1980s

	Firm	Amount *(tons)*
Total		**3,235,000** [a] [b]
United States	Occidental	1,500,000 [c] 600,000
Italy	Montedison	250,000
	Anic	100,000
France	Intsel	195,000
	Rhone Poulenc	40,000
Japan	Mitsui	100,000
Finland	Kemira	100,000
CEMA countries		350,000 [d]
East Germany	(Rostock)	300,000 [e]
Other countries		50,000

[a] Tonnage to be supplied under compensation deals is approximate and will be determined by the price of ammonia.
[b] An additional unspecified amount of ammonia probably will go to Belgium as partial payment for superphosphoric acid. Additional ammonia may also go to French and British firms under long-term agreements that include ammonia as one of the products to be supplied by the USSR.
[c] This transaction may result in the export of an additional 300,000 tons per year.
[d] In accordance with Soviet plans to provide CEMA countries with energy-intensive chemicals such as ammonia, shipments could be higher.
[e] In 1979 East Germany ordered from France a large nitrogen fertilizer plant that will use ammonia supplied by the USSR.

Assuming no further compensation deals are made, however, only 1.5 million tons of ammonia will be tied to compensation after 1990.

Nitrogen fertilizer exports are expected to expand rapidly in the mid-1980s (see table 8). Urea exports associated with compensation deals should amount to about 550,000 tons of nitrogen in 1985, more than 80 percent of which is associated with the Occidental fertilizer exchange agreement. Nitrogen fertilizer shipments to CEMA countries are expected to increase to 700,000 to 800,000 tons of nitrogen in 1985. Czechoslovakia has announced that growing domestic demand for nitrogen fertilizers will be met with imports from the USSR, with payment being made through export of high-technology low-energy chemicals—for example, paints, dyes, and additives. In addition, exports of nitrogen fertilizers, particularly urea, to other countries are expected to rise substantially. 25X1

Although apatite concentrate exports to the West increased in 1980-81, they are not expected to rise appreciably in the rest of the 1980s. The Soviets have found that Kola apatite concentrates have proved to be the only satisfactory, trouble-free feedstock for the country's phosphate fertilizer plants. Deliveries to Eastern Europe are not likely to increase—the Soviets warned these countries some years ago that supplies to meet increased demand would have to come from other sources. 25X1

The Soviets are unlikely to increase the small quantities of phosphate fertilizers that go to CEMA countries, but annual deliveries of 114,000 tons per year of P_2O_5 in the form of monoammonium phosphate to Eastern Europe in payment for assistance in the construction of the Kingisepp phosphorite mine will continue through 1985. 25X1

Barring further embargoes by the United States, the Soviets should receive, until 1997, 700,000 tons per year of P_2O_5 in the form of superphosphoric acid. Deliveries of 70,000 tons of SPA (P_2O_5 basis) from Belgium are scheduled to continue through 1985 and imports of 60,000 tons per year of merchant-grade phosphoric acid (P_2O_5 basis) from Finland are to continue through 1986. The Soviets recently signed a contract with Spain to supply 98,000 tons of SPA per year (P_2O_5 basis) for a 10-year period beginning in 1984. Additionally, the Soviets may import phosphate materials from Morocco, Tunisia, and possibly France. 25X1 25X1 25X1

Large quantities of potash will be available for export, but a possible oversupply in the world market in the mid-1980s may limit sales to non-Communist countries. Under the Occidental fertilizer exchange agreement, the USSR is to supply about 400,000 tons of potash (K_2O) annually to Occidental. The firm has taken only limited quantities of potash so far because

of the poor quality of the product. The USSR will continue to deliver to Poland 1 million tons of potash (K_2O) annually at least through 1985 and also will supply potash to other East European countries. 25X1

Soviet fertilizer exports in 1981 amounted to 3.6 million tons of nutrients, an 8-percent drop from the 1980 level. Hard currency countries accounted for most of the fall in potash shipments, reflecting the weakness in the potash market. Nitrogen fertilizer exports, mainly urea, rose by 24 percent to reach nearly 1.3 million tons of nitrogen. 25X1

Future Purchases of Western Equipment

Because of the enormous volume of Western fertilizer equipment and technology purchased during the 1970s, Moscow will cut back orders of fertilizer equipment in the 1980s. Potential purchases in the West include equipment to process potassium ores and to produce phosphoric acid and complex fertilizers as well as selected types of equipment, such as compressors. But hard currency constraints are likely to limit purchases of Western technology for the fertilizer industry even in these areas. 25X1

Moreover, the disappointing returns on imported equipment probably are one of the major arguments of those within the Soviet Union who oppose increased reliance on Western technology in the 1980s. As a result, domestic production and East European imports will supply an increasing amount of the equipment used in Soviet fertilizer plants. Leonid Kostandov, now promoted to Deputy Prime Minister, recently stated that the USSR does not intend to buy any more large-capacity ammonia units but instead will continue building its own medium-size plants with help from Czechoslovakia. According to Oleg Bogolomov, Director of the Institute of Economics of World Socialist Systems, the benefits that the USSR realized from saving time through foreign purchases of Western chemical equipment are outweighed by the disadvantages it is suffering from not having developed this industry for itself. He claims that in the future the USSR will import only those types of equipment that can directly help the USSR develop its own industries. 25X1

Appendix A

Statistical Tables

Table A-1
Soviet Fertilizer Industry:
Increase in Production Related
to Commissioning of New Capacity

Million tons of nutrients [a]

	1966-70	1971-75	1976-80		1981-85	1981	1982
			Plan	Actual	Plan		
Gross increase in fertilizer capacity [a]	7.9	9.1	13.9	9.4	10.3	0.5	NA
Increase in fertilizer production	5.7	8.9	11.9	2.8	11.2	1.2	NA

[a] Converted from "standard units" by multiplying by average nutrient content (24 percent) per standard unit.

Source: *Narodnoye khozyaystvo SSSR (various years).*

Table A-2
USSR: Fertilizer Production and Deliveries to Agriculture

Million tons [a]

	Production		Deliveries to Agriculture [b]			
	Standard Units	Nutrients	Total [c]		For Crops	
			Standard Units	Nutrients	Standard Units	Nutrients
1960	13.9	3.3	11.4	2.6	11.3 [d]	2.6
1965	31.3	7.4	27.1	6.3	26.9 [d]	6.3
1970	55.4	13.1	45.6	10.4	45.4	10.3
1971	61.4	14.7	50.5	11.5	50.0	11.4
1972	66.1	15.9	54.8	12.5	53.9	12.4
1973	72.3	17.4	60.1	13.8	58.5	13.5
1974	80.4	19.4	65.9	15.0	63.8	14.6
1975	90.2	22.0	75.7	17.7	73.5	17.3
1975 Plan	90.0	22.0	75.0	17.5	72.0	16.9
1976	92.2	22.6	77.7	18.3	75.0	17.7
1977	96.8	23.5	79.8	18.6	77.0	18.0
1978	98.0	23.7	81.2	18.8	79.0	18.4
1979	94.5	22.1	78.9	17.9	76.3	17.4
1980	103.9	24.8	84.7	19.3	82.0	18.8
1980 Plan	143.0	33.9	120.0	27.6	115.0	26.5
1981	109.1	26.0	87.4	19.8	84.2	19.2

[a] Data are expressed in Soviet standard units (a statistical concept) and 100-percent nutrients (N, P_2O_5, K_2O). Under the standard unit concept, nitrogen fertilizer contains 20.5-percent N; phosphate fertilizers, 18.7-percent P_2O_5; and potash fertilizers, 41.6-percent K_2O. Production data include chemical supplements to livestock feeds and probably some fertilizer materials that are used in industry and exports.
[b] Data are believed to be unadjusted for losses in fertilizer nutrients en route to farms and during storage.
[c] Total includes feed supplements as well as fertilizer for crops.
[d] Estimated.

Source: *Narodnoye khozyaystvo SSSR* (various years).

Table A-3
USSR: Fertilizer Production by Type [a]

Thousand tons of nutrients

	Total	Nitrogen (N)	Phosphate (P_2O_5) [b]	Potassium (K_2O)
1960	**3,281**	1,003	1,192	1,084
1965	**7,389**	2,712	2,300	2,368
1970	**13,099**	5,423	3,585	4,087
1971	**14,670**	6,055	3,802	4,807
1972	**15,931**	6,551	3,940	5,433
1973	**17,429**	7,241	4,261	5,918
1974	**19,352**	7,856	4,902	6,586
1975	**21,998**	8,535	5,511	7,944
1976	**22,590**	8,609	5,664	8,310
1977	**23,493**	9,114	6,024	8,347
1978	**23,653**	9,299	6,153	8,193
1979	**22,137**	9,151	6,344	6,635
1980	**24,767**	10,241	6,455	8,064
1981	**25,998**	10,705	6,836	8,449
1982	**26,700**	NA	NA	NA
Plan 1985	**36,000**	15,200	9,000	11,700

[a] Production includes exports, fertilizers, and nitrogen and phosphate animal feeds and also probably covers some fertilizers used for industrial purposes. Totals generally include small quantities of trace fertilizers. Data on fertilizers supplied to agriculture are unadjusted for losses.

[b] Data on phosphate fertilizers include ground phosphate rock used for direct application.

Source: All data except those for the 1985 plan are from *Narodnoye khozyaystvo SSSR* (various years).

Table A-4
USSR: Fertilizer Exports

Thousand tons of nutrients [a]

Type of Fertilizer	1965	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Total [b]	**481**	**1,775**	**2,050**	**2,206**	**2,449**	**2,881**	**3,002**	**2,952**	**3,304**	**3,297**	**2,890**	**3,908**	**3,593**
Phosphate (P_2O_5) [c]	54	135	109	95	92	97	101	101	119	134	121	134	143
Potash (K_2O)	343	1,309	1,622	1,706	1,997	2,321	2,490	2,316	2,506	2,401	1,986	2,747	2,182
Nitrogen (N)	84	331	319	405	360	463	411	535	678	763	783	1,027	1,268
Of which:													
Ammonium sulfate	68	181	167	187	178	179	144	186	214	236	217	217	225
Ammonium nitrate	3	47	35	49	36	36	37	37	38	50	40	58	45
Urea	13	102	117	168	146	249	230	311	426	476	525	752	997

[a] Nutrient values are estimated from official Soviet foreign trade data on fertilizers using the following assumptions concerning average nutrient content: phosphate fertilizers, 18.7 percent P_2O_5; potash, 41.6 percent K_2O; ammonium sulfate, 20.5 percent N; ammonium nitrate, 34 percent N; and urea, 46 percent N.
[b] Because of rounding, components may not add to the total shown.
[c] The Soviets do not report the small quantities of ammonium phosphate exports to East European countries.

Source: *Vneshnyaya torgovlya SSSR* (various years).

Table A-5
USSR: Estimates of Capacity Utilization in the Fertilizer Industry

Million tons

	New Capacity Installed (Standard Units)	Estimated [a] Total Capacity *(Standard units)*	Total Production		Capacity Use *(Percent)*
			Standard Units	Nutrients	
1950	NA	NA	5.5	1.2	
1955	NA	NA	9.7	NA	
1960	NA	17-17 [b]	13.9	3.3	82-82
1961	0.9 [c]	17.1-17.9	15.3	NA	89-85
1962	2.0 [c]	18.3-19.9	17.3	4.1	95-87
1963	7.4	24.9-27.3	19.9	4.6	80-73
1964	6.3	30.4-33.6	25.6	6.0	84-76
1965	6.7	36.3-40.3	31.3	7.4	86-78
1966	3.4	38.9-43.7	35.9	8.4	92-82
1967	3.3	41.4-47.0	40.1	9.4	97-85
1968	5.2	45.8-52.2	43.5	10.2	95-83
1969	11.4	56.4-63.6	45.9	10.8	81-72
1970	10.0	65.6-73.6	55.4	13.1	84-75
1971	3.0	67.8-76.6	61.4	14.7	91-80
1972	7.4	74.4-84.0	66.1	15.9	89-79
1973	9.0	82.6-93.0	72.3	17.4	88-78
1974	7.0	88.8-100.0	80.4	19.4	91-80
1975	11.6	99.6-111.6	90.2	22.0	91-81
1976	7.3	106.1-118.9	92.2	22.6	87-78
1977	4.0	109.3-122.9	96.8	23.5	89-79
1978	2.2	110.7-125.1	98.0	23.7	89-78
1979	15.8	125.7-140.9	94.5	22.1	75-67
1980	9.9	134.8-150.8	103.9	24.8	77-69
1981	2.1	136.1-152.9	109.1	26.0	80-71

[a] The upper end of the range of estimates of total capacity is based on an absence of retirement of any of the 17 million tons in place at the end of 1960; the lower range, on a linear rate of retirement required to retire all 17 million tons by the end of 1981.
[b] Estimated by Philip Hanson, *Trade and Technology in Soviet-Western Relations*, New York, 1981, p. 167.
[c] Estimated by CIA.

Sources: Unless otherwise indicated data are from *Narodnoye khozyaystvo SSSR* (various years) and Soviet sources cited by Philip Hanson, *Trade and Technology in Soviet-Western Relations*, New York, 1981 p. 167.

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Appendix B

USSR: Contracts for Purchase of Fertilizer Equipment and Technology From Non-Communist Countries, 1971-81

Year of Contract	Type of Plant or Equipment	Production Capacity (*thousand tons per year*)	Exporter		Plant Sites and Comments	Scheduled Completion Date
			Country	Firm		
1971	Ammonia (four plants)	1,800 total	Japan	Toyo Engineering Corporation	Contract covers only main machinery and equipment. Plant designs may be similar to some provided earlier by US firm.	NA
1973	Ammonia plant equipment: pipes, valves, motors, instruments, and electric machinery	NA	Japan	Toyo Engineering Corporation	Equipment may be for three plants, each with a capacity of 450,000 tons per year.	NA
	Four compressors	NA	United States	Clark Company		
1974	Electric vibrating screens for fertilizer production		United Kingdom	Clark Chapman, Ltd.	NA	NA
1974	Urea plant [a]	500	Italy	Snamprogetti ENI	Novomoskovsk. Contract covers design, engineering, procurement, and assistance with startup. Buy-back involves Italian counterpurchase of Soviet ammonia and possibly urea. See comment on 1975 Soviet order for two urea plants.	1978
1974	Urea plant [a]	500	Italy	Tecnimont Montedison	Gorlovka. Compensation arrangement involves purchase of Soviet ammonia by Montedison over a 10-year period starting in 1978.	1978
1974	Ammonia storage equipment	NA	France	Constructions Metalliques de Provence	Gorlovka	NA
1974	Urea-handling equipment	NA	West Germany	Pohlig-Heckel-Bleichert Vereinigte Maschinenfabriken AG	Odessa. Equipment for storing and loading urea.	NA
1974	Two fertilizer-handling facilities [a]	NA	United States	Occidental Petroleum	Odessa area and Ventspils. Contract covers design and construction of handling facilities at two ports. Product buy-back (ammonia) by Occidental is apparently involved.	1977
1974	Compressors	NA	United States	Dresser Industries	Most of the compressors will be used in production of ammonia.	NA

USSR: Contracts for Purchase of Fertilizer (Continued)
Equipment and Technology From
Non-Communist Countries, 1971-81

Year of Contract	Type of Plant or Equipment	Production Capacity (*thousand tons per year*)	Exporter		Plant Sites and Comments	Scheduled Completion Date
			Country	Firm		
1974	Installation for storage, cooling, and transport of ammonia	60 (storage)	France	Constructions Metalliques de Provence (CMP)	Tol'yatti. Storage and loading equipment will serve rail tank cars and pipeline facilities.	1977
1974	Ammonia (four plants) [a]	1,800 total	France United Kingdom Japan United Kingdom	Creusot-Loire Kellogg International Mitsubishi Doulton Industrial Products	Two plants at Gorlovka and two at Odessa. Repayment in part by shipment of ammonia to France beginning in 1978. Mitsubishi will supply four turbine compressors for $3.5 million of the contract value, and Doulton will supply filtration equipment for $178,800.	End of 1977
1974	Ammonia (four plants) [a]	1,800 total	United States	Chemico	Tol'yatti. Chemico will design and engineer plants and obtain materials and equipment. All equipment is to be purchased in the United States. Financing by US Export-Import Bank and US private banks. Compensation deal involving purchase of 600,000 tons/yr of Soviet ammonia for 10-year period by Occidental Petroleum Corp. The 600,000 tons/yr may also cover ammonia to be purchased in connection with Soviet order of fertilizer-handling equipment at two Soviet ports.	1978
1975	Urea (two plants) [a]	1,000 total	Italy	ENI Snamprogetti (an ENI subsidiary)	Both plants to be at Tol'yatti. Buy-back agreement also covers a Soviet order for a urea plant in 1974. Italian firm, Anic, to purchase 100,000 tons of Soviet ammonia annually over a 10-year period starting in 1979. Agreement may also call for Italian purchase of urea.	1977
1975	Ammonia pipeline [a] (Tol'yatti to Odessa)	2,500	France United States	Entrepose S.A., Vallourec S.A. (to supply pipe), Sofregaz (consultant) Occidental Petroleum, Williams Bros. (design consultant), Mapco Inc. (consultants)	Involves French credit of about $230 million. Compensation deal. Occidental to make counterpurchases of ammonia. The 2,400-kilometer pipeline, which has a capacity of 2.5 million tons of ammonia per year, includes a 300-kilometer branch line to Gorlovka.	1978

USSR: Contracts for Purchase of Fertilizer (Continued)
Equipment and Technology From
Non-Communist Countries, 1971-81

Year of Contract	Type of Plant or Equipment	Production Capacity (*thousand tons per year*)	Exporter		Plant Sites and Comments	Scheduled Completion Date
			Country	Firm		
1975	Ammonia (four plants) [a]	1,800 total	Japan	Mitsui and Company Toyo Engineering Corporation	Cherepovets, Novgorod, Dneprodzerzhinsk, and Dorogobuzh.	1979
1976	Urea (two plants) [a]	1,000 total	Italy	Tecnimont Montedison	Berezniki, Kemerovo. Compensation deal. USSR will supply 250,000 tons/yr of ammonia to Montedison for 10 years beginning in 1978.	
1976	Ammonia (four plants)	1,800 total	Japan United States	Toyo Engineering Corporation, Mitsui and Company Pullman Kellogg	Grodno, Rossosh, Novomoskovsk, Cherkassy. Plants will use Pullman Kellogg technology.	1980
1976	Multinutrient liquid fertilizer (seven plants)	2,000 total	France	Azote et Produits Chemiques PEC Engineering	Ventspils, Rovno, Sumy, Cherkassy, Voskresensk, Yefremov, Belorechensk. Plants are designed to use superphosphoric acid to be supplied by US Occidental Corporation.	1979
1976	Ammonia plant	450	Japan United States	Toyo Engineering Corporation Pullman Kellogg	Perm' Plant will use Pullman Kellogg technology.	1980
1976	Urea plant	500	Japan	Toyo Engineering Corporation Mitsui Toatsu	Mitsui Toatsu will supply technology.	1980
1976	Potassium chloride plant	1,100	France United States	PEC Engineering Swenson	Soligorsk. Vacuum installation of potassium chloride. Swenson will supply technology.	1979
1976	Multinutrient fertilizer (two plants)	1,200 total	Japan Norway	Toyo Engineering Corporation Norsk Hydro	Both plants to be at Novgorod. Norsk Hydro will supply technology.	1979 1981
1976	Multinutrient fertilizer (three plants)	2,400 total [a]	France	Speichim, Rhone Poulenc, Pechiny-Ungine Kuhlman	Meleuz, Belorechensk, Novyy Rozdol. Rhone Poulenc and Pechiny-Ungine Kuhlman will supply technology. Compensation deal under a Rhone-Poulenc agreement. USSR will supply chemicals and oil.	1980
1976	Phosphoric acid (four plants)	1,200 P_2O_5 total	Belgium	Coppee Rust	Chereporets (2), Meleuz, Belorechensk. Plants will use Prayon technology.	1978-79
1976	Centrifuges to chemical and fertilizer plants		West Germany	Kraus-Maffei AG	NA	NA
1976	Shovel loaders for potash mines		West Germany	GHH Sterkrade AG	NA	NA

USSR: Contracts for Purchase of Fertilizer (Continued)
Equipment and Technology From
Non-Communist Countries, 1971-81

Year of Contract	Type of Plant or Equipment	Production Capacity (*thousand tons per year*)	Exporter		Plant Sites and Comments	Scheduled Completion Date
			Country	Firm		
1976	Graphite heat exchangers for phosphoric acid plant (eight exchangers)	165 P_2O_5	Japan		NA	NA
1977	Pumps for 14 stations on Tol'yatti-Yuzhnyy ammonia pipeline	NA	United States		NA	NA
1977	Spare parts for potash mining machinery	NA	United States		NA	NA
1977	Phosphoric acid (three units)	400 P_2O_5	France United Kingdom	Spie Batignolles SA Swenson and Swift	Voskresensk, Balakovo. Units are for concentration of 28 percent acid to 54 percent acid. Swenson and Swift will supply technology.	1979
1977	Ammonia plant	450	Japan United States	Mitsui and Company Toyo Engineering Pullman Kellogg	Angarsk. Plant will use naptha feedstock. Pullman Kellogg will supply technology.	1980
1977	Denitrification units	NA	Japan	Mitsui Toatsu Chemicals	Novgorod. Units will be used in multinutrient fertilizer plants supplied by Toyo Engineering.	NA
1977	Potassium chloride crystallizer	1,425	France	Soc. Francaise Whiting Fermont, Mines de Potasse d'Alsace	Soligorsk. Mines de Potasse d'Alsace will supply technology.	1978
1977	Phosphoric acid plant [a]	165 P_2O_5	France	Krebs et Cie, Rhone Poulenc	Compensation deal under Rhone Poulenc agreement. USSR will supply raw materials. Rhone Poulenc will supply technology.	1980
1977	Multinutrient fertilizer (three plants)	1,830 total	Japan Norway	Toyo Engineering, Mitsui and Company Norsk Hydro	Rossosh (2), Dorogobuzh. Norsk Hydro will supply technology and some equipment.	1981
1977	Ammonia (10 plants)	4,500 total	Japan	Toyo Engineering, Mitsui and Company	Berezniki, Tol'yatti (3), Rossosh, Salavat, Kirovo-Chepetsk, Kemerovo (2), Fergana. Japan will supply main equipment (compressors, coolers, etc.) Czechoslovakia will supply reformer sections. Soviets will supply technology and some equipment.	By 1981
1977	Valves for ammonia plant	NA	Japan	Matsuura Koatsu Machinery Company	NA	NA

USSR: Contracts for Purchase of Fertilizer (Continued)
Equipment and Technology From
Non-Communist Countries, 1971-81

Year of Contract	Type of Plant or Equipment	Production Capacity (*thousand tons per year*)	Exporter		Plant Sites and Comments	Scheduled Completion Date
			Country	Firm		
1978	High-pressure fittings for plants producing fertilizers	NA	Japan	Mitsui and Company	NA	1979
1978	Ammonia plant control modules	NA	United States	NA	Odessa, Gorlovka, Tol'yatti.	1978
1978	Heat exchangers for phosphoric acid plant	NA	Sweden	Alfa-Laval AB	NA	NA
1981	Potassium chloride plant	2,000	West Germany	Lurgi Umwelt Chemotechnik GmbH	Berezniki. Contract covers equipment for crystallization, classification, compaction and granulation of potash ore and other equipment including trucks and lifting equipment.	1984

[a] Items represent purchases that involve or may involve "compensation" arrangements (that is product buy-back).

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Orders since 1975 taken from reports in Western press and journals.

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Appendix C

Raw Materials [14]

Phosphates

The Soviets claim that they have one-third of the world's prospected reserves of phosphate raw materials. The USSR ranks second to the United States in phosphate rock production—1980 output amounted to 25.5 million tons. The two main sources of phosphate rock in the USSR are the Kola mines in the far north of the European USSR and the Karatau mines in southern Kazakhstan. The Kola mines supply over three-fourths of domestic output in the form of apatite concentrate, while the Karatau mines provide most of the rest mainly via the elemental phosphorous route. A number of small deposits are mined in the European USSR to supply ground phosphate rock for direct application. Kola apatite concentrate is of very high quality, containing 39.4-percent P_2O_5. Karatau produces three types of products, mainly 23-percent P_2O_5 ore for thermal reduction to elemental phosphorus, but also some ground phosphorite and phosphorite concentrate (28-percent P_2O_5) for acid concentration.

According to a Soviet journal, reserves increased by 2.7 billion tons or by almost 50 percent during 1971-75 and continued to increase during 1976-80. The USSR is short of high-quality reserves, however. Most of the deposits discovered in recent years have been relatively small and have a low P_2O_5 nutrient content. The agreement with US Occidental Corporation, which will supply SPA to the USSR until 1997, buys the Soviets time to develop poorer quality ore deposits in more remote locations.

In 1980 about 25 percent of phosphate ores used in the production of phosphate fertilizer were low-nutrient ores. This share will become even larger in the 1981-85 plan period, limiting future development of phosphate fertilizer. For example, the Kola apatite mines are running low on high-quality reserves (see table C-1).

[14] Data in this section is based on Soviet and Western open literature.

Table C-1
USSR: Apatite Production in the Kola Peninsula

	1960	1965	1970	1975	1978	1980	1985 Plan
	Million tons						
Concentrate	3.82	7.55	11.33	15.33	15.96	17.4	19
Crude ore	8.5	19.1	27.2	38.1	42.3	47.3	53
	Percent						
P_2O_5 content	17.7	15.6	16.4	15.9	14.9	14.5	14

Source: *Soviet Geography* vol. XXIII No. 2, February 1982, p. 124.

Investment in the Kola apatite mines in 1981-85 is to reach 425 million rubles, nearly 60 percent of the funds allocated for the Chemical Mining Industry (Soyuzgorkhimprom) phosphate mines. Current plans for expansion in the 1980s call for the completion of a new open-pit mine with an annual capacity of 7 million tons and a third concentrate plant with an annual capacity of 8.8 million tons. The first stage of this concentrator, with an annual capacity of 2.4 million tons, is scheduled to begin operation in 1984 and is designed to beneficiate poor-quality apatite-nepheline ores.

A new apatite recovery line that went into operation at the end of 1981 at Kovdor will produce 440,000 tons of concentrate per year, almost doubling output at this site. The apatite, which is recovered from tailings of an iron ore beneficiation plant, is not popular with the fertilizer industry because of its high concentration of metals. It is mainly used for defluorinated phosphate feeds.

Mining capacity of phosphorite at the Karatau-Dzhambul complex is scheduled to double during the current five-year period to 18.5-20 million tons of ore. The second underground phosphorite mine is expected to begin production in 1984. At present only 57 percent of the mining capacity is utilized, and delays in the development of this complex are likely to continue into the mid-1980s. Lack of sintering or pelletizing facilities have prevented proper preparation of the ore, thus preventing full use of the capacity. Future development of the complex will depend also on the availability of electric power. The new South Kazakhstan thermal power station, now under construction, will not be completed until after 1985.

During 1981-85 the Soviets plan to produce phosphorite concentrate on the basis of the Chilisay (Kazakhstan) deposits and to begin building an apatite plant at Oshurkovo in Buryatiya. Nearly 100 million rubles have been earmarked for investment in the Chilisay mines in 1981-85. Progress at Chilisay has been slow, however, and construction of the mine and beneficiation plant to produce 1.77 million tons of concentrate per year is likely to continue throughout the current five-year period. At Oshurkovo an experimental beneficiation plant was commissioned in 1980, but full-scale operation to produce 700,000 tons of concentrate per year is not expected until after 1985.

During 1986-90 new phosphate raw material facilities may be developed at the Seligdar deposits in southern Yakutia, where the Soviets estimate reserves of 1.6 billion tons of phosphate ore. The Soviets recently reported the discovery of phosphate deposits at Rakvere in Estonia and in the Karelian ASSR, and plans are being made to exploit the Estonian deposit. Soviet geologists prospecting the Hobsogol phosphate deposits in Mongolia, which were thought to be a potential source, found the ores to be of low quality, but a phosphorite deposit near Erdenet in Mongolia is currently under evaluation.

We estimate that in 1985 the USSR probably will have about 7 million tons of P_2O_5 from domestic supplies and will import about 1 million tons. Although domestic supplies of phosphates will increase throughout the 1980s, they probably will not cover anticipated domestic requirements. The Soviets, however, have other sources of supply. Implementation of the agreement with Morocco could provide up to 10 million tons of phosphate rock after 1990 and smaller amounts in the last half of the eighties. Furthermore, the Soviets could, in a pinch, expand purchases of phosphoric acid and finished phosphate materials on world markets.

Sulfur

Sulfur is needed to produce sulfuric acid, a major input to phosphate fertilizers. Soviet output of sulfur in all forms, second to that of the United States, reached about 11 million tons in 1980. Nonetheless, sulfur is in short supply in the USSR, and domestic output probably will not satisfy requirements through 1985. Production costs are rising because of the need to process lower grade ores and because of the higher energy costs associated with the melting of sulfur underground. During 1976-80 costs in the Soyuzsera sulfur mining group rose by 31 percent. Production at the Gaurdak, Rozdol, and Yavorov sulfur mines is being expanded during 1981-85.

Because there are few large reserves of sulfur suitable for mining, the Soviets will turn increasingly to recovery of sulfur or sulfur-containing materials from sour gas, oil, metal smelters, and possibly coal. Sulfur available from these sources accounts for about one-third of output, but substantial quantities are currently being wasted. An increasing amount is being recovered from natural gas with a high sulfur content. More than 1 million tons of sulfur is obtained annually from the Orenburg gasfields. In 1981-85 the Soviets plan to increase sulfur recovered from natural gas by 25 percent. Sulfur recovery from the Mubarek gasfields in Uzbekistan is expected to increase 50 percent, to about 750,000 tons annually. A contract was recently signed with a French firm for the construction of a gas treatment and sulfur extraction complex at Astrakhan. The project, scheduled for completion in 1985, will provide nearly 3 million tons of sulfur annually. By 1990, Soviet sulfur production could be raised to about 14 million tons.

Although Poland now provides about 7 percent of Soviet sulfur consumption, large increases in deliveries from this source are unlikely. The USSR purchased smaller amounts of sulfur from Canada and the United States in 1981 and from Canada and Mexico in 1982.

Natural Gas

Ammonia, the major input to nitrogen fertilizer, is largely based on natural gas feedstock. In 1980 the share of ammonia produced from natural gas was about 90 percent, compared with 80 percent in 1975. The rest is obtained from coke oven gas and coke and coal. The USSR has large reserves of natural gas that can easily support the estimated level of ammonia production. In 1980 about 4 percent of natural gas output was used as feedstock for ammonia production. We project natural gas output, which grew 50 percent during 1976-80, to increase by about 37 percent to 590-600 billion cubic meters in 1981-85 and possibly to 710-730 billion cubic meters in 1990.

Potash

The USSR, the world's largest producer of potash fertilizers, has enormous reserves of the requisite inputs—potash salts—totaling nearly 4 billion tons of K_2O. Two major centers of potash production are in the western Urals and in Belorussia, and a smaller one is in the western Ukraine. The Belorussian mines, which account for about half of Soviet potash output, are well located to supply an important area of the domestic market, as well as Eastern Europe. Urals potash has to be shipped over longer distances to domestic users and, although produced in the interior of the country, has been the main product supplied to Western markets.

Despite the deterioration of the quality of the Urals concentrate and the technical and transportation difficulties cited previously, the long-range outlook for Soviet potash is favorable. Future production growth should provide for both domestic consumption and larger exports. Utilization of present capacity can be increased, and improved mining and ore-concentrating technology should permit a reduction in the large losses now experienced in mining and processing ores.

The Soviets plan to increase potash capacity by about 6.5 million tons of K_2O in 1981-85, but this expansion is more likely to carry over into the latter half of the decade. The Uralkali complex in Perm' Oblast—which includes mines at Berezniki and Solikamsk—will provide most of the scheduled new capacity. The Berezniki 4 mine ultimately will have a capacity of about 3 million tons of K_2O. At the Solikamsk mine an initial capacity of 700,000 tons of K_2O per year is expected to increase gradually to nearly 3 million tons per year. Expansions at the Belaruskaliy Production Association in Soligorsk, Belorussia, are scheduled to provide eventually about 2.5 million tons per year of K_2O. Since 1979 capacities for about 1.6 million tons per year have been added, and capacity for 830,000 tons per year is planned for the Soligorsk 4 mine. Additionally, promising deposits in northern Irkutsk Oblast and in the Turkmen SSR may be exploited in the latter half of the decade.

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Appendix D

Outlook for 1990

Moscow has not announced a fertilizer production plan for 1990. At the CPSU Central Committee Plenum on the Food Program in May 1982, Brezhnev revealed plans to deliver 30-32 million tons of fertilizer nutrients to agriculture for crops in 1990. This would imply production of about 38-41 million tons of nutrients—an increase of only 7 to 14 percent over planned output for 1985—if, as during the 1970s, 78 percent were allocated for crops. Alternatively, if the share of output allocated for crops were the same as that planned for 1985, production would be about 41-43.5 million tons, a 14- to 21-percent increase over 1985. In addition, agriculture is to receive 1.2 million tons of chemical feed additives.

According to current information on the planned construction of ammonia plants, capacity for an additional 3.3 million tons of ammonia (equivalent to 2.7 million tons of nitrogen) may be built during 1986-90, bringing total ammonia capacity to more than 32 million tons. Further gains in phosphate fertilizer production in the last half of the decade will depend primarily on raw material availability. Facilities at Chilisay and Oshurkovo, which are already being developed, could provide an additional 2.5 million tons of concentrate. Expansion of potash facilities could raise output to 11-12 million tons of K_2O.

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